

Appl. No. 10/617,572
Amdt. Dated July 20, 2005

Attorney Docket No.: BAT-102
Reply to Office Action of March 21, 2005

AMENDMENTS TO THE CLAIMS

Kindly amend claims 1, 5 and add new claims 29, 30, 31, 32, 33, 34, 35, 36, 37, 38, 39, 40 and 41 as shown in the listing of claims below. This listing of claims will replace all prior versions, and listings of claims in the application.

LISTING OF CLAIMS

1. (currently amended) A Digital Focus Lens System for providing an optical system having a plurality of selectable focal powers, comprising:
 - a first switchable element capable of being switched between a first-element first-state and a first-element second-state; and
 - and a second switchable element capable of being switched between a second-element first-state and a second-element second-state;
 - wherein the first switchable element has a focal length f_m^0 in the first-element first state and the second switchable element has the same focal length f_m^0 in the second-element first state,
 - wherein the first and second switchable elements are in optical communication with each other such that each of them may contribute to a cumulative focal power,
 - wherein, a first focal power may be selected by activation of the first switchable element to the first-element first-state and activation of the second switchable element to the second-element first-state,
 - wherein a second focal power is selected by activation of the first switchable element to the first-element second-state and activation of the second switchable element to the second-element first-state,
 - wherein a third focal power is selected by activation of the first switchable element to the first-element first-state and activation of the second switchable element to the second-element second-state, and
 - wherein a fourth focal power is selected by activation of the first switchable element to the first-element second-state and activation of the second switchable element to the second-element second-state.
2. (original) The system according to Claim 1 wherein a portion of the switchable elements include liquid crystal lenses.

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- 1 3. (original) The system according to Claim 1 wherein a portion of the switchable elements
2 include switchable holographic optical elements.
- 1 4. (original) The system according to Claim 1 wherein a portion of the switchable elements
2 include polymer dispersed liquid crystal.
- 1 5. (currently amended) The system according to Claim 1 wherein a portion of the switchable
2 elements form a [[lens]] stack of thin lenses.
- 1 6. (original) The system according to Claim 1 further comprising one or more non-switchable
2 elements for further modifying the optical properties of the system.
- 1 7. (original) The system according to Claim 1 further comprising any number of additional
2 switchable elements.
- 1 8. (original) The system according to Claim 1 wherein a portion of the switchable elements
2 include electro-optic lenses.
- 1 9. (original) The system according to Claim 1 wherein a portion of the switchable elements
2 include liquid crystal and polymer lenses.
- 1 10. (original) The system of claim 1 wherein the digital focus lens system is a digital telescope,
2 telephoto lens, or zoom lens.
- 1 11. (original) The system of claim 1 wherein the digital focus lens system is a digital camera.
- 1 12. (original) The system of claim 1 wherein the digital focus lens system is a digital projector.
- 1 13. (original) The system of claim 1 wherein the digital focus lens system is a digital microscope.
- 1 14. (original) The system of claim 1 further comprising a controller for providing control signals
2 that serve to activate the first and second switchable elements.
- 1 15. (original) The system according to Claim 1 wherein a portion of the switchable elements may
2 be continuously tuned between the focal powers of their respective first- and second-
3 states.
- 1 16. (original) The system of claim 1 further comprising one or more light sources for providing
2 light to be transmitted through and modified by the system.

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- 1 17. (original) The system of claim 16 wherein the light is received and transmitted by the first
2 and second switchable elements and is modified in accordance with the selected focal
3 powers of the first and second switchable elements.
- 1 18. (original) The system of claim 17 wherein a portion of the light transmitted by the system
2 forms one or more images.
- 1 19. (withdrawn) A method for fabricating a switchable element, comprising:
2 providing a structure having a conductive layer disposed between a substrate and a lens
3 function layer;
4 providing a die substrate with a spatially varying thickness pattern;
5 while the lens function layer is in a soft or viscous state, bringing the die surface into
6 contact with the lens function layer; and
7 hardening the lens function layer.
- 1 20. (withdrawn) The method of claim 19, further comprising attaching a second lens function
2 layer to a surface of the substrate and, while the second lens function layer is in a soft or
3 viscous state, bringing a die surface with a varying thickness pattern into contact with the
4 second lens function layer, hardening the second lens function layer and separating the
5 die surface from the second lens function layer.
- 1 21. (original) A method for controlling a digital lens system having N switchable elements in
2 optical communication with each other such that each of them may contribute to a
3 cumulative focal power, where N is 1 or more, wherein each switchable element is
4 capable of being switched between a first-state and a second-state, the method
5 comprising:
6 generating a control signal containing information for controlling the states of each of the
7 N switchable elements; and
8 coupling the control signal to the N switchable elements to set the state of each of the N
9 switchable elements,
10 and wherein a portion of the control signal includes a data stream comprising a control
11 word.
- 1 22. (original) The method of claim 21 wherein the control word is a digital word having a bit
2 field length of N bits.

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- 1 23. (original) The method of claim 19 wherein the control signal is an electrical signal.
- 1 24. (original) The method of claim 23 wherein the control signal is at a voltage, current or
2 frequency appropriate for activating the switchable elements to their desired states.
- 1 25. (withdrawn) The system of claim 1 wherein one or more of the first and second switchable
2 elements is made by:
3 providing a structure having a conductive layer disposed between a substrate and a lens
4 function layer;
5 providing a die substrate with a spatially varying thickness pattern;
6 while the lens function layer is in a soft or viscous state, bringing the die surface into
7 contact with the lens function layer; and
8 hardening the lens function layer.
- 1 26. (withdrawn) The system of claim 25 wherein fabrication of one or more of the first and
2 second switchable elements further includes:
3 attaching a second lens function layer to a surface of the substrate and, while the second
4 lens function layer is in a soft or viscous state, bringing a die surface with a varying
5 thickness pattern into contact with the second lens function layer, hardening the second
6 lens function layer and separating the die surface from the second lens function layer.
- 1 27. (previously presented) The system of claim 1 wherein one or more of the first and second
2 switchable elements has a focal power that is continuously tunable.
- 1 28. (previously presented) The system of claim 1 wherein one or more of the first and second
2 switchable elements includes a fluid.
- 1 29. (new) The system of claim 1 wherein the first and second switchable elements are two of N
2 switchable elements in a module of a device having one or more modules, where N is
3 greater than or equal to two,
4 wherein each of the N switchable elements is independently switchable between discrete
5 first and second states, wherein the N switchable elements are configured such that a
6 focal length of the system can be selected from a set of at least 2^N different values.

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30. (new) The system of claim 29 wherein the N switchable elements are configured such that:

$$f_{m,n}^1 = \left(\frac{2^n}{\Delta_m} + \frac{1}{f_{m,n}^0} \right)^{-1}$$

where $f_{m,n}^1$ is a focal length of the n^{th} switchable element in the m^{th} module when it is in its second state,

where $f_{m,n}^0$ is a focal length of the n^{th} switchable element in the m^{th} module when the it is in its first state,

where Δ_m is a constant for the m^{th} module having the dimensions of length and independent of n,

where n is an integer between 0 and N-1, and m is an integer that is less than or equal to the number of modules in the device.

31. (new) The device of claim 30 wherein $\Delta_m = f_{m,0}^1$,

where $f_{m,0}^1$ is the focal length for the 0^{th} switchable element in the m^{th} module when it is in its second state.

32. (new) The device of claim 30 wherein two or more switchable elements in the m^{th} module have substantially the same value for their first state focal lengths $f_{m,n}^0$ independent of n.

33. (new) The device of claim 30 wherein all switchable elements in the m^{th} module have substantially the same value for their first state focal lengths $f_{m,n}^0$ independent of n.

34. (new) The device of claim 30 wherein a portion of the switchable elements forms a lens stack.

35. (new) The device of claim 29 wherein the N switchable elements are stacked coaxially.

36 (new) The device of claim 35 wherein the N switchable elements are stacked such that each element is in approximate contact with any adjacent elements.

37. (new) The device of claim 1 wherein the first and second switchable elements are two of N switchable elements in a module of a device having M modules, where N is greater than or equal to two and M is a number greater than or equal to 1, wherein each of the N switchable elements is switchable between discrete first and

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second states, wherein a module focal length F_m , or module focal power P_m , of an m^{th} module are selectable from a set of 2^N focal lengths for the switchable elements, where m is an integer between 1 and M .

38. (new) The device of claim 36 wherein the N switchable elements are configured such that a focal length F_m for the m^{th} module can be selected from 2^{N-1} different possible values given by $F_m \in \left\{ \frac{\Delta_m}{0}, \frac{\Delta_m}{1}, \frac{\Delta_m}{2} \dots \frac{\Delta_m}{2^{N-1}-1} \right\}$ where Δ_m is a constant for the m^{th} module having the dimensions of length.

39. (new) The device of claim 36 wherein the N switchable elements are configured such that a focal power P_m for the m^{th} module is given by: $P_m \in \left\{ \left(\frac{0}{\Delta_m} \right), \left(\frac{1}{\Delta_m} \right), \left(\frac{2}{\Delta_m} \right) \dots \left(\frac{(2^N-1)}{\Delta_m} \right) \right\}$ where Δ_m is a constant for the m^{th} module having the dimensions of length.

40. (new) The system of claim 1 wherein the first and second switchable elements are two of N switchable elements in a module of a device having one or more modules, where N is greater than or equal to two, wherein each of the N switchable elements is independently switchable between discrete first and second states, wherein in the first states the focal lengths are the same for all N switchable elements, and wherein in their second states, the focal lengths of the N switchable elements are unique and, except for a smallest second state focal length, each second state focal length is twice as large another second state focal length.

41. (new) The system of claim 1 wherein the focal length f_m^0 is approximately infinite.